Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

CLASSIFICATION CONFIDENTIAL

CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT
CD NO.

50X1-HUM

COUNTRY	USSR	DATE OF INFORMATION	1947
SUBJECT	Scientific - Geophysics		
HOW PUBLISHED	Monthly periodical	DATE DIST.	8 Aug 1949
WHERE PUBLISHED	Moscow	NO. OF PAGES	4
DATE PUBLISHED	Feb 1947		
LANGUAGE	Russian	SUPPLEMENT TO REPORT NO.	

THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF ESPIONAGE ACT 50 U. S. C., 31 AND 32, AS AMENDED. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW. REPRODUCTION OF THIS FORM IS PROHIBITED.

THIS IS UNEVALUATED INFORMATION

SOURCE Trudy Instituta Teoreticheskoy Geofiziki, Vol II, No 2, 1947. (FDB Per Abs 45T17 -- Information requested.)

THE RELATION BETWEEN PLUMB-LINE DEFLECTION, GRADIENTS, AND RADII OF CURVATURE OF A GEOID

V. A. Kazinskiy

Summary: A method is given for deducing the formulas for studying the geoidal surface with the aid of gradients of the terrestrial gravitational field.

I

We shall write two equations serving to determine the component plumb-line deflections or deviations in the main planes: x and y, coinciding respectively with the meridian and the primary vertical (normal):

$$\xi = -\frac{T_x}{g}, \qquad \eta = -\frac{T_y}{g} \tag{1}$$

where $T_x = \frac{dT}{dx}$ and $T_y = \frac{dT}{dy}$ are the first derivatives of the disturbing potential T and g is the force of gravity at the surface of the geoid.

With the aid of these two equations, we shall find the analytical relation between: the component plumb-line deflections ξ and η, the second derivatives $T_\Delta = \frac{d^2T}{dx^2} - \frac{d^2T}{dy^2}$ and $T_{xy} = \frac{d^2T}{dxdy}$, and the radius of curvature R of the level surface of a geoid:

$$W(x, y, z) = C$$

CLASSIFICATION CONFIDENTIAL

STATE	X	NAVY	X	NSRB		DISTRIBUTION					
ARMY	X	AIR	X	FBI							

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

Differentiating (1), respectively with respect to x and y, we obtain

$$d\xi = -\frac{1}{g}\left[T_{xx} + T_{xy}\,\mathrm{tg}\,A\right]dx,$$

$$d\eta = -\frac{1}{g}\left[T_{yy} + T_{xy}\,\mathrm{ctg}\,A\right]dy. \qquad (2)$$

where A is the azimuth of the element of length $dl = \sqrt{dx^2 + dy^2} = \frac{dx}{\cos A} = \frac{dy}{\sin A}$

If the first equation of (2) is multiplied by sin A and the second equation by cos A, then after subtracting one equation from the other we obtain:

$$d\xi \sin A - d\eta \cos A = T^{(l)}_{xy}dl, \qquad (3)$$

where

$$T^{(l)}_{xy} = \frac{1}{2}T_{\Delta} \sin 2A + T_{xy}\cos 2A, \qquad (4)$$

hence, after integration, we obtain Eötvös' equation:

$$(\xi_2 - \xi_1) \sin A - (\eta_2 - \eta_1) \cos A = \frac{1}{g}\int_1^2 T^{(l)}_{xy}dl, \qquad (5)$$

which finds application in the study of geoidal surfaces.

III

After the equations of (2) are multiplied respectively by cos A and sin A, we add them term by term. As a result of a not inconsiderable number of transformations, we obtain:

$$d\xi \cos A + d\eta \sin A =$$

$$= -\frac{1}{g}\left[T_{xx}\cos^2 A + T_{yy}\sin^2 A + 2T_{xy}\sin A\cos A\right]dl, \qquad (6)$$

hence, after integrating in the same interval as used previously, we obtain:

$$(\xi_2 - \xi_1) \cos A + (\eta_2 - \eta_1) \sin A =$$

$$= -\frac{1}{g}\int_1^2 \left[T_{xx}\cos^2 A + T_{yy}\sin^2 A + 2T_{xy}\sin A\cos A\right]dl. \qquad (7)$$

The equation just obtained above may be employed to determine the radius of curvature of a level surface of a geoid. Thus, it is sufficient to turn our attention to the nature of the integrand in function (7). It represents the negative quantity of the product of surface curvature $(-\frac{1}{R})$ multiplied by the acceleration of the force of gravity (g), that is to say it equals (2):

$$-\frac{g}{R} = T_{xx}\cos^2 A + T_{yy}\sin^2 A + 2T_{xy}\sin A\cos A. \qquad (8)$$

Consequently, instead of (6), we have:

$$\frac{d\xi}{dl}\cos A + \frac{d\eta}{dl}\sin A = \frac{1}{R}, \qquad (9)$$

which gives, in the planes of the meridian and of the primary vertical (normal), the equalities:

$$\frac{d\xi}{dl} = \frac{1}{R_M}, \quad \frac{d\eta}{dl} = \frac{1}{R_N}. \qquad (10)$$

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

50X1-HUM

We note, for clarity, that $R_L \neq$ and $R_N \neq N$ [2]. The expression (7) determines the deviation of the curvature of the geoid from the curvature of the surface of reference (deviation). Therefore, in order to obtain the complete curvature of a geoid, it is obviously necessary to calculate also the curvature of the surface, relative to which the geoidal surface is studied.

IV

We return again to the equations in (2) and we set $A = \alpha + (A - \alpha)$, where α is the azimuth of the vector of plumb-line deflection $\varepsilon = \sqrt{\xi^2 + \eta^2}$. Hence, for the case $A - \alpha = 0$, we obtain:

$$d\xi = -\frac{1}{g}\left[T_{xx} + T_{xy}\operatorname{tg}\alpha\right]dx, \qquad (11)$$

$$d\eta = -\frac{1}{g}\left[T_{yy} + T_{xy}\operatorname{ctg}\alpha\right]dy,$$

Hence, keeping in mind that:

$$d\xi = d\varepsilon \cdot \cos\alpha, \quad \text{and} \quad dx = dl \cdot \cos\alpha,$$
$$d\eta = d\varepsilon \cdot \sin\alpha, \qquad\qquad dy = dl \cdot \sin\alpha$$

we obtain:

$$T_{xx} + T_{xy}\operatorname{tg}\alpha = T_{yy} + T_{xy}\operatorname{ctg}\alpha. \qquad (12)$$

Consequently,

$$\operatorname{tg}\alpha - \operatorname{ctg}\alpha = \frac{T_\Delta}{T_{xy}}, \quad \frac{d\xi}{d\eta} = \operatorname{ctg}\alpha. \qquad (13)$$

Setting:

$$\operatorname{tg}\alpha - \operatorname{ctg}\alpha = -\frac{2}{\operatorname{tg}2\alpha}, \qquad (14)$$

we obtain:

$$\operatorname{tg}2\alpha = -\frac{2T_{xy}}{T_\Delta}. \qquad (15)$$

Equation (15) determines α in the direction of the plumb-line deflection ε if T_Δ and T_{xy} are known.

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3

CONFIDENTIAL

50X1-HUM

BIBLIOGRAPHY

1. V. A. Kazinskiy. Variometric Method of Determining Plumb-line Deflection. (Dissertation, 1938).

2. A. A. Mikhaylov. A Course of Gravimetry and Theory of Earth's Shape, Geodezizdat, 1939.

3. L. V. Sorokin. A Course of Gravimetry and Gravimetric Prospecting. Gostoptekhizdat, 1941.

- E N D -

CONFIDENTIAL

Sanitized Copy Approved for Release 2011/07/07 : CIA-RDP80-00809A000600240777-3